ADDITIONAL FEES

Applicant has added by amendment one (1) independent claim in excess of 3 independent claims at a claim fee of $100.00 for a subtotal of $100.00 and four (4) additional claims in excess of 20 claims at a claim fee of $25.00 per claim for a subtotal of $100.00 thereby making a total additional claim fee due of $200.00. A check for $200.00 paying the additional claim fee is enclosed herewith.

No additional fees are deemed due herein for filing of this AMENDMENT. However, if any fees are required for any reason, please charge the same to Deposit Account No. 13-2515.

REMARKS

Claims

Claims 1 through 46 were originally filed in this Application. Claims 32 through 46 have been withdrawn as being drawn to a non-elected invention. Claim 8 has been cancelled. New claims 47 through 50 have been added by this Amendment. Thus, claims 1-7, 9-31 and 47-50 are pending.

Specification

The Examiner objected to the specification regarding the use of the trademark ARONITE as used in the specification to identify a material as ARONITE brand Liquid Sandstone and

Limestone. The trademark was used properly at lines 17 and 18 on Page 2 of the specification.

At lines 6 through 20 on Page 20 the trademark is not capitalized and the generic terminology was not included as in the specification at lines 17 and 18 on Page 2.

Accordingly the specification has been amended to refer to the material as ARONITE brand Liquid Sandstone and Limestone.

With this amendment, the Examiner's objection to the specification has been overcome.

Applicant has amended the specification at lines 9 through 13 at Page 5 to define that the ceramic micro balloons themselves have a diameter as follows:

> * * * in the form of ceramic micro balloons having a diameter size (hereinafter referred to as "size") in the range of about 50 microns to about 500 microns and thinly coated * * *)

The above diameter of a micro balloon is shown in Figs. 8A, 8B and 8C of the drawing. As shown in Fig. 8A, it is noted that the ceramic balloons themselves are not pre-coated with the bonding agent.

In order to make the specification clear on this structure, the specification has been amended at lines 1 through 14 on Page 4 as follows:

> * * *formed of fly ash in the form of ceramic micro balloons having a size in the range of about 50 microns to about 500 microns and thinly coated with a bonding agent when the flyash is in the bonding agent as described hereinbelow in Fig 8A, e.g. amine cured epoxy resin,* * *

Double Patenting Under 35 U.S.C 101

Claim 10 has been amended to depend on claim 2. Claim 9 is depended on claim 1.

As such, the potential double patenting rejection under 35 U.S.C 101 has been overcome.

Non-statutory Double Patenting Based on Judicially Created Doctrine

Enclosed herewith is a terminal disclaimer on Form PTO/SB/25 to overcome the provisional obviousness-type double patenting rejection based on claims 1-14 of co-pending application Serial No: 10/960,468 filed October 7, 2004. The terminal disclaimer has been signed by the undersigned as attorney of record. A check in the amount of $65.00 is enclosed

herewith paying the filing fee of $65.00 due under 37 CFR Section 1.20(d) required for filing the terminal disclaimer.

With the filing of the terminal disclaimer and payment of the filing fee therefore, the provisional obviousness-type double patenting rejection based on claims 1-14 of co-pending application Serial No: 10/960,468 filed October 7, 2004 has been overcome.

Claim Rejections - 35 USC § 112, First Paragraph

The Examiner rejected claims 1-31 under 35 U.S.C. 112, first paragraph based on the coating layer as defined by the claims.

A careful review of the specification discloses at line 19 through line 24 at Page 21 and line 1 through line 4 on Page 22 that the substrate has a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F. At line 3 through line 7 of page 23 that the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate. If the coating layer includes a treatment material, then combination of the coefficients of thermal expansion substantially equal to that of the substrate.

This is important in that if the substrate has a coefficient of thermal expansion substrate in the range of about

6PPM/inch/per degree F to about 7PPM/inch/per degree F and the coefficient of thermal expansion coating layer is substantially matched to that of the substrate, any differential stress between the substrate and coating layer will not be significant.

The materials that comprise the coating layer are set forth in the specification as follows:

Synthetic material, faux finish, faux surface,	Lines 18 through 19, Page 12
Simulated stone, simulated panel coating, a faux finish, a faux finish having a milled aggregate in a water based acrylic emulsion, a faux finish fabricated from an ARONITE brand Liquid Sandstone and Limestone,	Lines 6 through 11, Page 20
aggregate	Line 3, Page 23
coating material and aggregate	Line 9, Page 23
aggregate material	Line 13, Page 23
aggregate	Line 10, Page 25
Milled aggregate	Line 10, Page 26

Thus, the specification clearly provides examples of materials used in the coating layer material that have the above-described relationship between the substrate and coating layer.

The coating layer may include a treating material such as disclosed at lines 1 through 5 on Page 20, to wit:

> The coating layer may comprise a coating material and a coating treatment material, e.g. aggregate, to obtain a desired or selected coefficient of thermal expansion or comprise a thin coating layer having an expansion characteristic configured to substantially absorb any difference in the coefficient of thermal expansions between the coating layer and substrate, or both.

Thus, it is the blending of the coefficients of thermal expansion of the combination of the aggregate, in this example, used in the coating layer and as the treatment material and the blending or combination of the coefficients of thermal expansion is selected such that the resulting coefficients of thermal expansion of the combination will substantially be in the range of the substrate.

A person skilled in the art in determining the selection of appropriate a materials for use as a coating layer or coating layer and treatment material in combination would look in a reference book for materials having a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F.

For example, a GOOGLE search under "coefficient of thermal expansion" and "materials" located a reference entitled *Comparison of Materials: Coefficient of Thermal Expansion.* A copy of the GOOGLE page 1 search results and reference entitled *Comparison of Materials: Coefficient of Thermal Expansion* which are identified as Exhibit A and enclosed herewith.

A person skilled in the art knows that when blending two materials together in equal amounts, the coefficient of thermal expansion (CTE) will be an average of the two materials CTE. For example, a mixture of material A, with a CTE of 20 ppm/inch/per degree F, with material B having a CTE of 5ppm/inch/per degree F will have a CTE of 12.5 ppm/inch/per degree F. The ratio of the blend will determine where the CTE will fall between the two materials.

Another example would be a mixture of 80% material A, with a CTE of 20 ppm/inch/per degree F, with 20% of material B having

a CTE of 5ppm/inch/per degree F will have a CTE of 17 ppm/inch/per degree F. Thus, the more of the low CTE material that is mixed into the mixture, the lower will be the CTE of the blend.

In order to sharply and clearly define the above in the claims, the claims have been amended as follows.

Claim 1 has been amended to recite that the substrate has a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F and the coating layer is defined as a coating layer applied to said at least one outer surface and having a coefficient of thermal expansion substantially equal to that of the substrate. The following language of claim 1 relating to the expansion characteristic has been deleted to overcome the examiner's rejection of claim 1:

> and a expansion characteristic configured to substantially absorb any difference in the coefficient of thermal expansions between the coating layer and substrate to substantially eliminate any physical deformation between the substrate and coating layer forming an exterior

outer surface having a fabricated ornamental appearance.

With respect to claim 8, claim 8 has been cancelled.

Claim 9 has been amended to provide that the coating layer is configured of a coating material including a treatment material having a coefficient of thermal expansion which in combination with the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate.

An antecedent basis for this claim is set forth in the specification at lines 19 through 21 on Page 9.

Claim 10 has been amended to now depend on claim 2 and to provide that the coating layer is configured of a coating material including a treatment material having a coefficient of thermal expansion which in combination with the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate.

An antecedent basis for this claim is set forth in the specification at lines 19 through 21 on Page 9.

Claim 11 has been amended to provide that the coating layer is configured of a coating material including a treatment material having a coefficient of thermal expansion which in combination with the coating layer has a coefficient of thermal

expansion substantially equal to that of the substrate and a thin coating material finishing layer having an expansion characteristic which is configured to be combined with the coefficient of thermal expansion of the coating layer in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F to substantially eliminate any physical deformation between the substrate and coating layer forming an exterior outer surface having a fabricated ornamental appearance.

An antecedent basis for this claim is set forth in the specification at lines 21 through 25 on Page 23 and lines 1 through 4,on Page 24.

By so amending claims 9, 10 and 11, it is now clear that it is the combination or blend of the coefficients of thermal expansions of the materials used in the coating layer and treatment materials that determine the final coefficient of thermal expansions of the coating layer. As such the final coefficient of thermal expansions of the coating layer would meet the physicals characteristics if the claim that the final coating layer applied to said at least one outer surface has a coefficient of thermal expansion—substantially equal to that of the substrate.

Claim 22 has been similarly amended to recite that the coating layer comprises a coating material <u>including</u> a coating treatment material <u>having a coefficient of thermal expansion</u> which in combination with the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate.

As such the final coefficient of thermal expansions of the coating layer would meet the physicals characteristics if the claim that the final coating layer applied to said at least one outer surface has a coefficient of thermal expansion substantially equal to that of the substrate.

With the above explanations and amendment to the claims as discussed above the rejection of claims 1-31 under 35 U.S.C., first paragraph has been overcome.

Claim Rejections - 35 USC § 112, Second Paragraph

The Examiner rejected claims 1-31 under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Applicant has proceeded as follows to overcome this rejection.

Claim 1 has been amended to define that the substrate is formed of fly ash in the form of ceramic balloons having a

diameter size of in the range of about 50 microns to about 500 microns and enclosed in a bonding agent in a ratio that is configured to optimize strength and coefficient of thermal expansion and with the ceramic balloons located on at least one outer surface of the substrate exposed to form an open cell structure of ceramic micro balloons on at least one outer surface of the substrate.

With this amendment is now clear that the 50-500 microns refer to individual ceramic balloon in diameter and that the ceramic balloons are enclosed in a bonding agent in a ratio that is configured to optimize strength and coefficient of thermal expansion and with the ceramic balloons located on at least one outer surface of the substrate exposed to form an open cell structure of ceramic micro balloons on at least one outer surface of the substrate.

Thus the ceramic balloons as a whole, except for the ceramic balloons located on at least one outer surface of the substrate, as whole are enclosed with the bonding agent.

Further, it is now clear that with the ceramic balloons located on at least one outer surface of the substrate exposed to form an open cell structure of ceramic micro balloons, the

open cell structure is formed on at least one outer surface of the substrate.

The process of using the bonding agent to enclose the ceramic balloons is described in the specification in connection with the description of Fig. 8 at lines 12 to 14 on Page 28.

Claim 1 has been further amended at line 8 to delete "having at least one of" and add the word --and having--such that the claim now read"

> a coating layer applied to said at least one outer surface and having a coefficient of thermal expansion substantially equal to that of the substrate

Thus, the requirement for an antecedent for "said at least one outer surface having at least one of a coefficient of thermal expansion" in line 8 has been eliminated. The claim clearly recites that a coating layer applied to said at least one outer surface has a coefficient of thermal expansion substantially equal to that of the substrate. It is also now clear that there is only one coefficient of thermal expansion.

Claim 1 has been amended to <u>delete</u> the following language:

> and a expansion characteristic configured to substantially absorb any difference in the

coefficient of thermal expansions between the coating layer and substrate to substantially eliminate any physical deformation between the substrate and coating layer

such that the claim now reads:

a coating layer applied to said at least one outer surface and having a coefficient of thermal expansion substantially equal to that of the substrate wherein the coating layer forms an exterior outer surface having a fabricated ornamental appearance.

With the above amendment to claim 1, it is now clear that the final language reads:

forms an exterior outer surface having a fabricated ornamental appearance

such that the exterior outer surface is formed by the coating layer itself.

With respect to claims 1 and 8-17 and the physical characteristics of the substrate and coating materials, Applicant is not required to include in the specification a complete listing of all materials that could be used to practice this invention. One reason is that a person skilled in the art

would have the parameter to follow of the substrate of the decorative panel having a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F and the coating layer having a coefficient of thermal expansion substantially equal to that of the substrate wherein the coating layer forms an exterior outer surface having a fabricated ornamental appearance.

As discussed above, a person skilled in the art would reference the coefficient of thermal expansion of a desired material to be used as a coating layer and if coefficient of thermal expansion is outside of the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F, it would not be operational for use in practicing this invention. For this reason, Applicant is not claiming any conceivable combination of ingredients either presently existing or which might be discovered in the future. As such, the claims are not too broad and indefinite.

With respect to Claims 2 and 3, claims 2 and 3 have been amended to define the ceramic micro balloons size as the diameter.

Claim 4 has been amended to provide that the bonding agent is selected from a group consisting of an amine cured epoxy

resin, epoxy resin <u>or</u> thermal setting polymer. Thus the bonding agent can be: (i) an amine cured epoxy resin; (ii) an epoxy resin; *<u>or</u>* (iii) a thermal setting polymer or a combination of one or more of the above.

Claim 5, 6 and 7 are retained as originally filed.

Claim 8 has been cancelled.

With respect to claim 11, claim 11 has been amended to provide that the coating layer is configured of a coating material <u>including</u> a treatment material <u>having a coefficient of thermal expansion</u> which in combination with the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate and a thin coating material finishing layer <u>formed over said coating layer</u> having an expansion characteristic which is configured to be combined with the coefficient of thermal expansions of the coating layer and <u>is in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F to</u> substantially eliminate any physical deformation between the substrate and coating layer <u>wherein the thin coating material forms</u> an exterior outer surface having a fabricated ornamental appearance.

With respect to claim 11, as amended the thin coating material forms an exterior outer surface having a fabricated

ornamental appearance and covers the coating layer recited in line 1 of claim 11.

With these amendments to claim 11, line 2 is now a complete sentence in that the wording now reads:

> the coating layer is configured of a coating material including a treatment material having a coefficient of thermal expansion which in combination with the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate and a thin coating material finishing layer formed over said coating layer having an expansion characteristic which is configured to be combined with the coefficient of thermal expansions of the coating layer in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F to substantially eliminate any physical deformation between the substrate and coating layer wherein the thin coating material forms an exterior outer surface having a fabricated ornamental appearance.

Thus, in claim 11, the sentence is now complete.

With respect to claim 16, the term Thermal K is known in the art to mean "thermal conductivity. A search of yahoo.com located 16 definitions for "Thermal K" to mean "thermal conductivity and the download from the Yahoo.com search is enclosed herewith as Exhibit B.

In order to provide an antecedent basis for the term "thermal K", the specification at lines 1 through 3 on Page 9 has been amended to read "* * * thermal K (known as thermal conductivity) * * *".

Claim 16 has been amended to define "Thermal K" as "thermal conductivity" to overcome the rejection of the Examiner.

With respect to claim 17, claim 17 has been amended to delete the article "the" in line 2 and now reads as follows:

> 17. The decorative structure of claim 1 wherein said substrate is configured to have a Glass Transition Temperature, Tg, of greater than 200 degree F

With this amendment to claim 17, the sentence is complete.

Claim 19 has been amended in a manner similar to claim 1 as discussed above.

As such. It is now clear that the size of about 50-500 microns refers to the individual ceramic balloon diameter.

The ceramic balloons as a whole, except for the ceramic balloons located on at least one outer surface of the substrate, as whole are enclosed with the bonding agent.

Further, it is now clear that with the ceramic balloons located on at least one outer surface of the substrate exposed to form an open cell structure of ceramic micro balloons, the open cell structure is formed on at least one outer surface of the substrate.

The process of using the bonding agent to enclose the ceramic balloons is described in the specification in connection with the description of Fig. 8 at lines 12 to 14 on Page 28.

In claim 19, it is clear that there is one coefficient of thermal expansion for the coating layer.

Claim 22 has been amended to provide that the coating layer comprises a coating material including a coating treatment material having a coefficient of thermal expansion which in combination with the coating layer has a coefficient of thermal expansion substantially equal to that of the substrate.

With respect to claims 19 and 22 and the physical characteristics of the substrate and coating materials,

Applicant is not required to include in the specification a complete listing of all materials that could be used to practice this invention. One reason is that a person skilled in the art would have the parameter to follow of the substrate of the decorative panel having a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F and the coating layer having a coefficient of thermal expansion substantially equal to that of the substrate wherein the coating layer forms an exterior outer surface having a fabricated ornamental appearance.

As discussed above, a person skilled in the art would reference the coefficient of thermal expansion of a desired material to be used as a coating layer and if coefficient of thermal expansion is outside of the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F, it would not be operational for use in practicing this invention. For this reason, Applicant is not claiming any conceivable combination of ingredients either presently existing or which might be discovered in the future. As such, the claims are not too broad and indefinite.

With respect to claim 20, claim 20 has been amended to read as follows:

The decorative panel of claim 19 wherein the ceramic micro balloons diameter size range from about 50 microns to about 300 microns.

With respect to claim 21, claim 21 has been amended to read as follows:

The decorative panel of claim 20 wherein the ceramic micro balloons have a diameter size of about 200 microns.

Thus, with the amendments to claims 20 and 21 it is clear that the size of about 50-300 microns or 200 microns refers to the individual balloon in diameter.

With respect to claim 26, claim 26 has been amended with respect to the term "Thermal K" by adding thereafter the words "(thermal conductivity) such the phrase now reds "Thermal K (thermal conductivity) of about 0.1 Watt/meter/K and glass transition temperature Tg >200F".

With respect to claim 26, the term Thermal K is known in the art to mean "thermal conductivity. A search of yahoo.com located 16 definitions for "Thermal K" to mean "thermal conductivity and the download from the Yahoo.com search is enclosed herewith as Exhibit B.

In order to provide an antecedent basis for the term "thermal K", the specification at line 13 through line 16 on Page 11has been amended to read "* * * thermal K (known as thermal conductivity) * * *".

Claim 26 has been amended to define "Thermal K" as "thermal conductivity" to overcome the rejection of the Examiner.

With respect to claim 31, Claim 31 has been amended with respect to the reference to the trademark "Aronite" by deleting "Aronite", replacing the same with --ARONITE-- and inserting after the word "brand" the words --Liquid Sandstone and Limestone--. With these amendments claim 31 now reads as follows:

> The decorative panel of claim 27 wherein said exterior outer comprises a faux finish fabricated from an ARONITE brand Liquid Sandstone and Limestone coating material.

As noted above, the specification at Lines 6 through line 12 on Page 30 has been amended to refer to the material as ARONITE brand Liquid Sandstone and Limestone thereby providing an antecedent basis for use of the trademark in claim 31.

With this amendment, the Examiner's rejection to claim 31 has been overcome.

In summary, with the amendments made to the claims 1-31 as discussed above and for the reasons set forth above, the Examiner's rejection of claim 1-31 under 35 U.S.C. 112, second paragraph have been overcome.

New Claims 47 through 50

As noted above, new claims 47 through 50 have been added by this Amendment.

Claim 47 is dependent on claim 1 and defines that the coating layer applied to said at least one outer surface has a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F.

An antecedent basis therefor is in the specification as described above.

Claim 48 is dependent on claim 1 and defines that the coating material is selected from a group having a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree consisting of an aggregate material, a synthetic material, simulated panel coating, a faux finish material, a faux finish having a milled aggregate in a water based acrylic emulsion, a faux surface material and an ARONITE brand Liquid Sandstone and Limestone coating material.

An antecedent basis therefor is in the specification as described above.

Claim 49 defines a decorative structure comprising

a substrate formed of fly ash in the form of ceramic balloons having a diameter size of in the range of about 50 microns to about 500 microns and enclosed in a bonding agent in a ratio that is configured to optimize strength and coefficient of thermal expansion and with the ceramic balloons located on at least one outer surface of the substrate exposed to form an open cell structure of ceramic micro balloons on at least one outer surface of the substrate and wherein said substrate has a coefficient of thermal expansion in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F.

Claim 49 is essentially uses the claim 1 definition of a substrate for defining the decorative structure. This structure is definite and is not anticipated, disclosed, suggested or taught by the prior art.

Claim 50 is dependent on claim 49 and includes a coating layer having applied to said at least one outer surface—having a coefficient of thermal expansion—substantially equal to that of the substrate and in the range of about 6PPM/inch/per degree F to about 7PPM/inch/per degree F.

Claims 49 and 50 are patentable for the same reason as set forth above with respect to claim 1.

SUMMARY

Claims 1-7, 9-31 and 47-50 are pending in this Application

Applicant has made a diligent effort to overcome the Examiners objections to the specification and to amending the claim to overcome the voluminous rejection thereof under 35 U.S.C. 112, first paragraph and under 35 U.S.C. 112, second paragraph. In the instances where the Examiners objections or reasons for rejecting the claims required an antecedent basis in the specification, the specification has been amended to make the claim language consistent with use of the same in the claims.

The Claims 1-7, 9-31 and 47-50 are definite, clear and distinctly claim the subject matter that Applicant regards as the invention.

Applicant verily believes that this Application is now in condition for allowance and the Examiner is respectfully requested to issue a Notice of Allowability and a formal Notice of Allowance.

Respectfully submitted

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Dated: November 9, 2005

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EXHIBIT A

Tangram Technology Ltd. - Thermal Expansion
The thermal expansion of **materials** is one of the most powerful forces known ...
The linear **coefficient of thermal expansion** for a material is a measure of ...
www.tangram.co.uk/TI-Thermal_Expansion_of_PVC-U.html - 9k - Oct 29, 2005 - Cached - Similar pages

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"coefficient of thermal expansion" ar Search

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"coefficient of thermal expansion" and "materia | Search | Advanced Search Preferences

The **"AND"** operator is unnecessary -- we include all search terms by default. [details]

Web Results **1** - **10** of about **161,000** for **"coefficient of thermal expansion" and "materials"**. (**0.17** seconds)

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www.handyharmancanada.com/TheBrazingBook/comparis.htm - 24k - Cached - Similar pages

PMIC - Advanced **Materials** Testing Laboratory. Thermal Expansion ...
Coefficient of Thermal Expansion - CTE - is defined as the fractional increase ... Standard reference **materials** (SRM) traceable to the National Institute of ...
www.pmiclab.com/testing/ThermalExpansion.html - 18k - Cached - Similar pages

PMIC - CTE testing laboratory. **Coefficient of Thermal Expansion ...**
PMIC is a Advanced **Materials** Testing Laboratory, CTE - **Coefficient of Thermal** ... CTE, cte, CTE - **Coefficient of Thermal Expansion**, CTE testing laboratory, ...
www.pmiclab.com/dwpages/ - 33k - Cached - Similar pages
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Coefficient of thermal expansion - Wikipedia, the free encyclopedia
The **coefficient of thermal expansion** is used in two ways: ... For ordinary **materials**, the linear thermal expansion coefficient is approximately 1/3 the ...
en.wikipedia.org/wiki/Coefficient_of_thermal_expansion - 16k - Cached - Similar pages

Coefficient of thermal expansion (linear)
... 40-500 134 Gutta percha 54.9 23-38 114 Impression **materials** Silicone, ... 50 147 Titanium 11.9 23 126 Restorative **materials** Acrylic Sevriton 92.0 24- 88 ...
www.lib.umich.edu/dentlib/ Dental_tables/Coefthermexp.html - 9k - Cached - Similar pages

Thermal expansion
Definition of the **Coefficient of Thermal Expansion** (CTE). The **coefficient of thermal** ... Metals Infobase and **Materials** Infobase http://www.ili.co.uk ...
irc.swan.ac.uk/ThExpansion.htm - 26k - Cached - Similar pages

[PDF] Ultra-High Accuracy Measurement of the **Coefficient of Thermal ...**
File Format: PDF/Adobe Acrobat
the **Coefficient of Thermal Expansion**. for Ultra-Low Expansion **Materials**. By Dr. Vivek G. Badami, Dr. Michael Linder. Abstract ...
www.corning.com/semiconductoroptics/ pdf/badami_hi-res_20020309.pdf - Similar pages

[PDF] 1 Cellular solid structures with unbounded thermal expansion ...
File Format: PDF/Adobe Acrobat - View as HTML
Staff, "Comparison of **materials**; **coefficient of thermal expansion**", **Materials** Engineering. 103 (1986) 25-7. 4. JL Cribb, "Shrinkage and thermal expansion of ...
silver.neep.wisc.edu/~lakes/HiAlpha.pdf - Similar pages

PSIgate - Physical Sciences Information Gateway: Search/Browse Results
The notes cover thermal properties of **materials** and include information on the ... linear **coefficient of thermal expansion**, volume **coefficient of thermal** ...
www.psigate.ac.uk/.../ psisearch.pl?term1=coefficient+of+thermal+expansion&limit=0&subject=All - 22k - Cached - Similar pages

Comparisons of Materials: Coefficient of Thermal Expansion

Values represent high and low sides of a range of *typical* values.
Value at room temperature only.
Value for a temperature range between room temperature and 212-750°F/100-390°C
Value for a temperature range between room temperature and 1000-1800°F/540-980°C
Value for a temperature range between room temperature and 2200-2875°F/1205-1580°C

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(* or mm/mm)

Material	10-6 in./in.*/°F		10-5 in./in.*/°C	
	High	Low	High	Low
Zinc & its Alloys	19.3	10.8	3.5	1.9
Lead & its Alloys	16.3	14.4	2.9	2.6
Magnesium Alloys	16	14	2.8	2.5
Aluminum & its Alloys	13.7	11.7	2.5	2.1
Tin & its Alloys	13		2.3	
Tin & Aluminum Brasses	11.8	10.3	2.1	1.8
Plain & Leaded Brasses	11.6	10	2.1	1.8
Silver	10.9		2.0	
Cr-Ni-Fe Superalloys	10.5	9.2	1.9	1.7
Heat Resistant Alloys (cast)	10.5	6.4	1.9	1.1
Nodular or Ductile Irons (cast)	10.4	6.6	1.9	1.2
Stainless Steels (cast)	10.4	6.4	1.9	1.1
Tin Bronzes (cast)	10.3	10	1.8	1.8
Austenitic Stainless Steels	10.2	9	1.8	1.6
Phosphor Silicon Bronzes	10.2	9.6	1.8	1.7
Coppers	9.8	7.7	1.8	1.4
Nickel-Base Superalloys	9.8		1.8	
Aluminum Bronzes (cast)	9.5	9	1.8	1.6
Cobalt-Base Superalloys	9.4	6.8	1.7	1.2
Beryllium Copper	9.3		1.7	
Cupro-Nickels & Nickel Silvers	9.5	9	1.7	1.6
Nickel & its Alloys	9.2	6.8	1.7	1.2
Cr-Ni-Co-Fe Superalloys	9.1	8	1.6	1.4
Alloy Steels	8.6	6.3	1.5	1.1
Carbon Free-Cutting Steels	8.4	8.1	1.5	1.5

Alloy Steels (cast)	8.3	8	1.5	1.4
Age Hardenable Stainless Steels	8.2	5.5	1.5	1.0
Gold	7.9		1.4	
High Temperature Steels	7.9	6.3	1.4	1.1
Ultra High Strength Steels	7.6	5.7	1.4	1.0
Malleable Irons	7.5	5.9	1.3	1.1
Titanium Carbide Cermet	7.5	4.3	1.3	.8
Wrought Irons	7.4		1.3	
Titanium & its Alloys	7.1	4.9	1.3	.9
Cobalt	6.8		1.2	
Martensitic Stainless Steels	6.5	5.5	1.2	1.0
Nitriding Steels	6.5		1.2	
Palladium	6.5		1.2	
Beryllium	6.4		1.1	
Chromium Carbide Cermet	6.3	5.8	1.1	1.0
Thorium	6.2		1.1	
Ferritic Stainless Steels	6	5.8	1.1	1.0
Gray Irons (cast)	6		1.1	
Beryllium Carbide	5.8		1.0	
Low Expansion Nickel Alloys'	5.5	1.5	1.0	.3
Beryllia &. Thoria	5.3		.9	
Alumina Cermets	5.2	4.7	.9	.8
Molybdenum Disilicide	5.1		.9	
Ruthenium	5.1		.9	
Platinum	4.9		.9	
Vanadium	4.8		.9	
Rhodium	4.6		.8	
Tantalum Carbide	4.6		.8	
Boron Nitride	4.3		.8	
Columbium & its Alloys	4.1	3.8	.7	.68
Titanium Carbide	4.1		.7	
Steatite	4	3.3	.7	.6
Tungsten Carbide Cermet	3.9	2.5	.7	.4
Iridium	3.8		.7	
Alumina Ceramics	3.7	3.1	.7	.6
Zirconium Carbide	3.7		.7	
Osmium and Tantalum	3.6		.6	
Zirconium & its Alloys	3.6	3.1	.6	.55
Hafnium	3.4		.6	

Zirconia	3.1		.6	
Molybdenum & its Alloys	3.1	2.7	.6	.5
Silicon Carbide	2.4	2.2	.4	.39
Tungsten	2.2		.4	
Electrical Ceramics	2		.4	
Zircon	1.8	1.3	.3	.2
Boron Carbide	1.7		.3	
Carbon and Graphite	1.5	1.3	.3	.2

EXHIBIT B

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...209-226 (1985) 269. The **Thermal** Conductivity of Fluid Air, **K** Stephan and A. Laesecke...283. Viscosity and **Thermal** Conductivity of Dry...the Gaseous Phase, **K** Kadoya, N. Matsunaga...Recommended Values for the **Thermal** Expansivity of Silicon from 0 to 1000 **K**, C. A. Swenson, Vol...
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[PDF] Appendix B

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...primary model for **thermal** conductivity represents...polynomials l l t t id red **k t k t a b k k** = â...critical enhancement for **thermal** conductivity is represented...t d t d t d c red **k k t k d k k t k** d...Prediction of the **thermal** conductivity of refrigerants...vapor phases from 63 **K** to 2000 **K** with pressures...

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